REMARKS

The Examiner objected to the drawings because they include a reference character, 21, that is not described in the specification. Applicants note that this objection was addressed in the office action response mailed June 28, 2001. In a telephone conversation, the Examiner stated that the file lacked a clean copy of the amendments made to the paragraph starting at page 8, line 23 in the June 28, 2001 response. Accordingly, this amendment amends the paragraph beginning at page 8, line 23 as if the amendments made to that paragraph in the paper mailed June 28, 2001 were not entered. Applicants respectfully request that the Examiner withdraw the objection to the drawings.

Claims 1, 4, 8, 10, 11, and 14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Biing-Jye et al., U.S. Patent No. 6,169,294 (hereinafter "Biing-Jye") in view of Hunt et al., U.S. Patent No. 5,362,977 (hereinafter "Hunt"). Claim 1 is amended to recite "a multi-layer contact external to the semiconductor heterostructure, the multi-layer contact comprising: a metallic reflector layer; a continuous uniform conducting sheet that makes ohmic contact to the heterostructure; and a conductive barrier layer interposing the reflector layer and the continuous uniform conducting sheet." Since Hunt's barrier layer is a "dielectric material" (see column 2, line 60 of Hunt) and therefore not conductive, and Biing-Jye does not teach any kind of barrier layer, even the combination of Hunt and Biing-Jye does not teach all the elements of claim 1. Accordingly, claim 1 is allowable over Hunt and Biing-Jye. Claim 4 is canceled, rendering its rejection moot. Claims 8 and 10 depend from claim 1 and are therefore allowable for at least the same reason as claim 1.

Claim 11 is amended to incorporate the limitations of claim 13. Claims 3 and 13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Biing-Jye and Hunt as applied to claims 1 and 11 and further in view of Sugiura et al., U.S. Patent No. 5,932,896 (hereinafter "Sugiura"). Claim 13 is canceled. Claim 11 is amended to recite "wherein the multi-layer

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contact has a specific contact resistance less than 10^{-2} Ω-cm^2." Accordingly, the specific contact resistance across the entire multi-layer contact must be less than the 10^{-2} Ω-cm^2. The entire contact resistance will depend on the two interfaces in the structure defined in claim 11, the interface between the semiconductor heterostructure and the multilayer contact, and the interface between the reflector layer and the conducting sheet. Sugiura teaches a method of controlling the resistance only in the interface between the semiconductor and the contact. Applicants can find no teaching in Sugiura of controlling the resistance between the layers of a multi-layer contact. If an additional layer were added to Sugiura's contact, the resistance could easily exceed the resistance taught by claim 11. Accordingly, even in combination, Biing-Jye, Hunt, and Sugiura do not teach all the elements of claim 11.

Regarding claim 3, claim 3 depends from claim 1. Sugiura adds nothing to the deficiencies of Biing-Jye and Hunt with respect to claim 1, thus claim 3 is allowable for at least the same reasons as claim 1.

Claims 5 and 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Biing-Jye and Hunt as applied to claims 1 and 11 and further in view of Nakagawa et al., U.S. Patent No. 6,190,937 (hereinafter "Nakagawa"). Claims 5 and 15 depend from claims 1 and 11. Nakagawa adds nothing to the deficiencies of Biing-Jye, Hunt, and Sugiura with respect to claims 1 and 11, thus claims 5 and 15 are allowable for at least the same reasons as claims 1 and 11. In addition, the Examiner cites Nakagawa as teaching a particular thickness for a reflector layer. Applicants can find no teaching in Nakagawa that the "collecting electrode" cited by the Examiner is reflective. Since it would not be obvious to use thicknesses taught for non-reflective electrodes, a person of skill in the art would not be motivated to combine the thicknesses taught in Nakagawa with the electrode structures of Biing-Jye and Hunt. Accordingly, claims 5 and 15 are allowable for this additional reason.

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Claims 6 and 16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Biing-Jye and Hunt as applied to claims 1 and 11 and further in view of Liu et al., U.S. Patent No. 5,789,771 (hereinafter "Liu"). Claims 6 and 16 depend from claims 1 and 11. Liu adds nothing to the deficiencies of Biing-Jye, Hunt, and Sugiura with respect to claims 1 and 11, thus claims 6 and 16 are allowable for at least the same reasons as claims 1 and 11. In addition, the Examiner cites Liu as teaching a particular thickness for a conductive sheet in a multi-layer contact external to the semiconductor heterostructure. Actually, the passage quoted by the Examiner deals with the thickness of a semiconductor layer, not a multi-layer contact. Accordingly, the combination of Biing-Jye, Hunt, and Liu do not teach all the elements of claims 6 and 16 and claims 6 and 16 are allowable for this additional reason.

Claims 7 and 17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Biing-Jye and Hunt as applied to claims 1 and 11 and further in view of Schetzina, U.S. Patent No. 5,351,255. Claims 7 and 17 depend from claims 1 and 11. Schetzina adds nothing to the deficiencies of Biing-Jye, Hunt, and Sugiura with respect to claims 1 and 11, thus claims 7 and 17 are allowable for at least the same reasons as claims 1 and 11.

Claim 9 is rejected under 35 U.S.C. 103(a) as being unpatentable over Biing-Jye and Hunt as applied to claims 1 and 8 and further in view of Haitz et al., U.S. Patent No. 5,917,202. Claim 9 depends from claim 1. Haitz et al. adds nothing to the deficiencies of Biing-Jye and Hunt with respect to claim 1, thus claim 9 is allowable for at least the same reasons as claim 1.

Claim 18 is rejected under 35 U.S.C. 103(a) as being unpatentable over Biing-Jye and Hunt as applied to claim 11 further in view of Okazaki, U.S. Patent No. 5,990,500. Claim 18 depends from claim 11. Okazaki adds nothing to the deficiencies of Biing-Jye, Hunt, and Sugiura with respect to claim 11, thus claim 18 is allowable for at least the same reasons as claim 11.

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In view of the above arguments, Applicants respectfully request allowance of all pending claims. Should the Examiner have any questions, the Examiner is invited to call the undersigned at (408) 382-0480.

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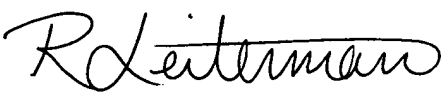
Respectfully submitted,



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ATTACHMENT A

IN THE SPECIFICATION

The paragraph starting on page 8, line 23 is amended as follows:

Figure 4 illustrates an alternate embodiment of the multi-layer contact 22 to a semiconductor device 20 with multiple contact layers 22A, 22B, and 22C. Ohmic layer 22A provides ohmic contact to semiconductor 21. A barrier metal layer 22B interposes the ohmic layer 22A and the reflector layer[s] 22C. The barrier layer 22B is used to prevent diffusion of the ohmic layer 22A into the reflector layer 22C, thus preventing the creation of any inter-metallics. These inter-metallics could degrade the specific contact resistance and reflectivity of the contact and thus the efficiency of the device. This is a reliability issue that should be avoided for long lasting devices. The barrier metal layer should be kept thin, e.g. < 100Å, to minimize light absorption and should be as reflective as possible to contribute to the reflectivity of the contact. Exact metals will vary depending on the ohmic layer 22A and reflector layer[s] 22C but some candidates include Ni, Co, NiO, Rh, Cr, Pt, Mo, Ti, TiW, WSi, WSi:N, TaSi, TaSi:N, InSnO, or TiW:N. The [contact] ohmic layer 22A and reflector layer 22C [layers] provide the same function as described in the first embodiment.

IN THE CLAIMS

Claims are amended as follows:

1. (Four Times Amended) A light-emitting device comprising:

a semiconductor heterostructure including at least one p-type layer and one n-type layer; and

a p contact and an n contact, the p contact electrically connected to the p-type layer, the n contact electrically connected to the n-type layer, wherein at least one of the p and n contacts is a multi-layered contact external to the semiconductor heterostructure, the multi-layered contact comprising: [and including]

a metallic reflector layer; [and]

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a continuous [conductive layer that makes ohmic contact through a] uniform conducting sheet that makes ohmic contact to the heterostructure; and

a conductive barrier layer interposing the reflector layer and the continuous uniform conducting sheet;

wherein the multi-layer contact has a reflectivity greater than 75% for light at an operating wavelength of the light-emitting device.

6. (Twice Amended) A device, as defined in claim 1, wherein the [conductive layer] sheet that makes ohmic contact to the heterostructure has a thickness less than 200 Å.

9. (Twice Amended) A device, as defined in claim 8, wherein the [conductive layer] sheet that makes ohmic contact to the heterostructure includes Ni and Ag.

11. (Four times Amended) A light-emitting semiconductor device comprising:

a [GaN-based] semiconductor heterostructure having at least one p-type and one n-type layer; and

a p contact and an n contact, the p contact electrically connected to the p-type layer, the n contact electrically connected to the n-type layer, wherein at least one of the p and n contacts is a multi-layer contact external to the semiconductor heterostructure, the multi-layer contact comprising: [and including]

a metallic reflector layer; and

a continuous [conductive layer that makes ohmic contact through a] uniform conducting sheet that makes ohmic contact to the heterostructure;

wherein the multi-layer contact has a reflectivity greater than 75% for light at an operating wavelength of the light-emitting device and wherein the multi-layer contact has a specific contact resistance less than 10^{-2} Ω-cm^2.

14. (Twice Amended) A device, as defined in claim 11, the multi-layer contact further comprising a barrier layer interposing the reflector layer and the [conductive layer]

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sheet.

16. (Twice Amended) A device, as defined in claim 11, the [conductive layer] sheet that makes ohmic contact to the heterostructure having a thickness less than 200 Å.

18. (Twice Amended) A device, as defined in claim 11, wherein the [conductive layer] sheet that makes ohmic contact to the heterostructure is selected from the group that consists of Ti, Au/NiO, and Ni/Au.

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